

REMARKS

This AMENDMENT is filed in reply to the outstanding Office Action of October 28, 2003, and is believed to be fully responsive thereto for reasons set forth below in greater detail.

In the Office Action, the Examiner rejected Claims 1-2 and 19-20 under 35 U.S.C. §102(e), as allegedly being anticipated by Krishnaswamy et al. (U.S. Patent No. 6,622,300)(hereinafter "Krishnaswamy"). The Examiner additionally rejected Claims 3-8, 11, 18, 21-27, 30, 36-45, 48 and 54 under 35 U.S.C. §103(a), as allegedly being unpatentable over Krishnaswamy in view of Holzle et al. (U.S. Patent No. 5,995,754) (hereinafter "Holzle1"). The Examiner additionally rejected Claims 9, 28 and 46 under 35 U.S.C. §103(a), as allegedly being unpatentable over Krishnaswamy in view of Holzle1 and further in view of O'Donnell (U.S. Patent No. 6,374,369) (hereinafter "O'Donnell"). The Examiner additionally rejected Claims 10, 29 and 47 under 35 U.S.C. §103(a), as allegedly being unpatentable over Krishnaswamy in view of Holzle1 and further in view of Benitez (U.S. Patent No. 6,189,141) (hereinafter "Benitez"). The Examiner additionally rejected Claims 12, 31 and 49 under 35 U.S.C. §103(a), as allegedly being unpatentable over Krishnaswamy in view of Holzle1 and further in view of Ronstrom (U.S. Patent Publication No.2002/0010913) (hereinafter "Ronstrom"). The Examiner additionally rejected Claim 13 under 35 U.S.C. §103(a), as allegedly being unpatentable over Krishnaswamy in view of the reference to Alpern et al. entitled "The Jalapeno Virtual Machine", IBM Systems Journal, Vol. 39, No. 1, February 2000 (hereinafter "Alpern"). Finally, the Examiner rejected Claims 14-17, 32-35, and 50-53 under 35 U.S.C. §103(a), as allegedly being unpatentable over Krishnaswamy in view of the reference to Urs Hölzle, et al entitled "Reconciling Responsiveness with Performance in Pure Object-Oriented Languages", by, ACM

Transactions on Programming Languages and Systems, Vol. 18, No. 4, July 1996, pp. 355-400 (hereinafter "Holzle2").

As a preliminary matter, Applicants take this opportunity to correct minor informalities in the specification, for instance, at pages 9, 17-18 and 25, by entering current U.S. Patent Application Serial Numbers for referenced commonly-owned, co-pending patent applications.

With respect to the substantive rejections of independent Claims 1 and 19 under 35 U.S.C. §102(e), the Applicants' respectfully traverse.

The thrust of the applicants' traversal is that Krishnaswamy wholly teaches away from the adaptive optimizing approach for optimizing performance of a computer program executing in an execution environment, as the approach taken by applicants' invention. Particularly, Krishnaswamy's teaching describes problems with a dynamic optimizer that lives in non-kernel, i.e., user's, space (See Krishnaswamy at Col 2, line 24), and specifically concludes that such an approach "causes significant problems when performing dynamic optimization." Therefore, Krishnaswamy's teaching and claims focus on a dynamic optimization system that uses a kernel module (See Krishnaswamy Claim 1 at Col. 11, lines 11 and 20) and kernel memory space (Krishnaswamy Claim 1 at Col. 11, line 28). The present invention, on the other hand, is directed to dynamic optimization that is not limited to kernel space. Thus, it is respectfully submitted, that Krishnaswamy is completely different and is thus not applicable.

Furthermore, the Examiner alleges that Krishnaswamy also teaches the second element of Claim 1, i.e., the element directed to "a controller device for receiving said characterized raw profile data from said runtime measurements sub-system and analyzing said data for determining whether a level of program optimization for said executing program is to be performed by a compiler device, said controller generating a compilation plan in accordance with

a determined level of optimization. Namely, the Examiner summarily concludes in regard to Krishnaswamy that "since the optimization is performed dynamically using the profile data, various levels of optimization is inherently performed depending on the result of the analysis of the profile data".

Applicants respectfully do not agree with this assessment because the level of optimization set forth in this element of Claim 1 is directed to general optimization levels of a compiler, which are a collection of optimizations that are not directly dependent on profile data, but characterizations thereof (See page 21, line 27 - page 22 line 15, of the present patent application). Thus, this second element of Claim 1 describes choosing which of these levels to perform. Respectfully, Krishnaswamy does not cover this level of optimization.

Furthermore, the Examiner alleges that Krishnaswamy also teaches the third element of Claim 1, i.e., the element directed to "a recompilation sub-system for receiving a compilation plan from said controller and invoking a compiler device for performing said level of program optimization of said executing program in accordance with said compilation plan." While the Examiner alleges that this element of Claim 1 is covered by Krishnaswamy at Col. 5, lines 51-59, applicants respectfully disagree. Rather, the quoted text of Krishnaswamy covers the process of installing the optimized translation so that it is used in future executions, whereas the third element set forth in Claim 1, describes the process of implementing the compiler to actually perform a level of program optimization (i.e., a compilation).

With respect to the rejection of independent Claim 19 as being anticipated by Krishnaswamy, applicant respectfully disagrees. First of all, the claimed element a) setting forth a method step for sampling an executing program is not taught by Krishnaswamy. Krishnaswamy does not teach a sampling technique as implemented in the present invention but rather, at col. 6,

lines 21-34, suggests a low-level "sampling" mechanism such as collecting data from the processor's Performance Monitoring Units) PMU's. Further, with respect to Claim 19, elements c) and d) the arguments submitted hereinabove with respect to the second and third elements of Claim 1 are applicable in traversal of the rejection of Claim 19.

Thus, as independent Claims 1 and 19 set forth novel features of a complete operative system and method for adaptively optimizing a computer program executing in an execution environment, that operates in user space (not kernel space) and thus, having elements that are not taught by Krishnaswamy, the Examiner is respectfully requested to withdraw the rejection of Claims 1 and 19 under 35 U.S.C. §102(e) and all claims dependent therefrom.

Furthermore, with respect to the Examiner's rejection of Claims 3-8, 11, 18, 21-27, 30, 36-45, 48, and 54 as being obvious in light of the teachings of Krishnaswamy and Holzel, applicants respectfully disagree.

Respectfully, although the system of Krishnaswamy implements a low-level sampling mechanism to collect data from the processor PMU's, the task of mapping from such low-level profile data (traces of executed binary instructions) to the kind of information required for Holzel's techniques (which are directed to method activations; method invocations, call edges) is a difficult task, even for those quite skilled in the art because the necessary translation information (between high and low level) is not typically preserved because of space efficiency reasons.

Furthermore, 1 does not teach sampling. Rather, in the Holzel system, a counter is incremented unconditionally every time particular points in the program execution are reached. In the sampling disclosed in the present invention, a counter is incremented only some of the times each particular point in the program execution is reached. This is an important

distinction because a key innovation of the invention as set forth in Claims 1 and 19 is the effective use of profile data sampling to guide dynamic optimization in a virtual machine. The techniques that must be used by a dynamic optimization system to effectively use sampled values instead of exhaustively counted values are substantially different, and thus the teaching of Holzle1 directed to exploiting exhaustively counted values could not be applied in the context of Krishnaswamy's system, even by one skilled in the art, without undue experimentation.

Therefore the combination of the teachings of Krishnaswamy and Holzle1 would require undue experimentation and would not in fact be obvious to combine even to one skilled in the art.

For this reason, the Examiner is respectfully requested to withdraw the rejection of Claims 3-8, 11, 18, 21-27, 30, 36-45, 48, and 54 as being obvious in light of the teachings of Krishnaswamy and Holzle1.

The foregoing remarks in traversal of the rejection of Claims 3-8, 11, 18, 21-27, 30, 36-45, 48, and 54 as being obvious in light of the teachings of Krishnaswamy and Holzle1 are also applicable to the rejection of Claims 14-17, 32-35, 50-53 based on obviousness over Krishnaswamy in view of Holzle2.

Furthermore, with specific regard respect to the Examiner's rejection of Claims 9, 28 and 46 as being obvious over Krishnaswamy in view of Holzle1 and O'Donnell, applicants respectfully disagree. That is, the additional passage in O'Donnell cited by the Examiner discusses how a software developer would optimize their software.

However, the claims of the present invention discuss a system (e.g., the recompilation sub-system) implementing an automatic process with no human intervention for optimizing software. Thus, further to the arguments in traversal of independent Claims 1, 19 and

37 (discussed hereinabove) to which these respective Claims 9, 28 and 46 indirectly depend, it would not be obvious to one skilled in the art how the teaching of O'Donnell could be used to automatically perform a corresponding method step of inserting intrusive profiling as set forth in Claims 9, 28 and 46. As such, the Examiner is respectfully requested to withdraw the rejections of these claims.

Furthermore, in response to the Examiner's specific rejection of Claims 10, 29 and 47, the Examiner alleges that levels of optimization are inherently performed based upon the combined Krishnaswami and Holzle1 references. However, the addition of Benitez allegedly setting forth a method identifier does not make up the deficiencies of the combined Krishnaswami and Holzle1 references. That is, as argued herein, the combined references do not teach or suggest the level of optimization described (i.e., in Claims 1 and 10) which are general optimization levels of a compiler, and which are not dependent on profile data (see Page 21, line 27 - page 22 line 15 of the present specification). Krishnaswamy does not cover this level of optimization. As such, the Examiner is respectfully requested to withdraw the rejections of these claims.

Furthermore, with specific regard to the rejection of Claim 16, Claim 16 of the invention sets forth the values of variables in the executing program. Holzle2 teaches how invocation counters, which are variables inserted by the dynamic optimization system, not variables in the original program, are used to drive recompilation. Although both are variables they are very different. The variables in claim 16 are semantically meaningful to the programmer, i.e., they are part of their algorithm. The variables (invocation counters) in Holzle2 are not created by the programmer and thus, have no semantic meaning in the algorithm. Thus, it

is not obvious how the teaching of Holzle2 could be used to derive claim 16 in light of Krishnaswamy.

Respectfully, the same argument holds for the Examiner's rejection of Claim 17 in which the Examiner relies on the combination of Holzle2 and Krishnaswamy as teaching this claim. However, the argument presented in connection with traversal of Claim 16 additionally applies, i.e., Holzle2 teaches how invocation counters can be used to drive recompilation. These invocation counters do not correspond to control flow paths within an executed method, which represents semantics at the application level. Thus, it is not obvious how the teaching of Holzle2 could be used to derive Claim 17 in light of Krishnaswamy.

This application is now believed to be in condition for allowance, and a Notice of Allowance is respectfully requested. If the Examiner believes a telephone conference might expedite prosecution of this case, it is respectfully requested that the Examiner call applicant's attorney at (516) 742-4343.

Respectfully submitted,

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